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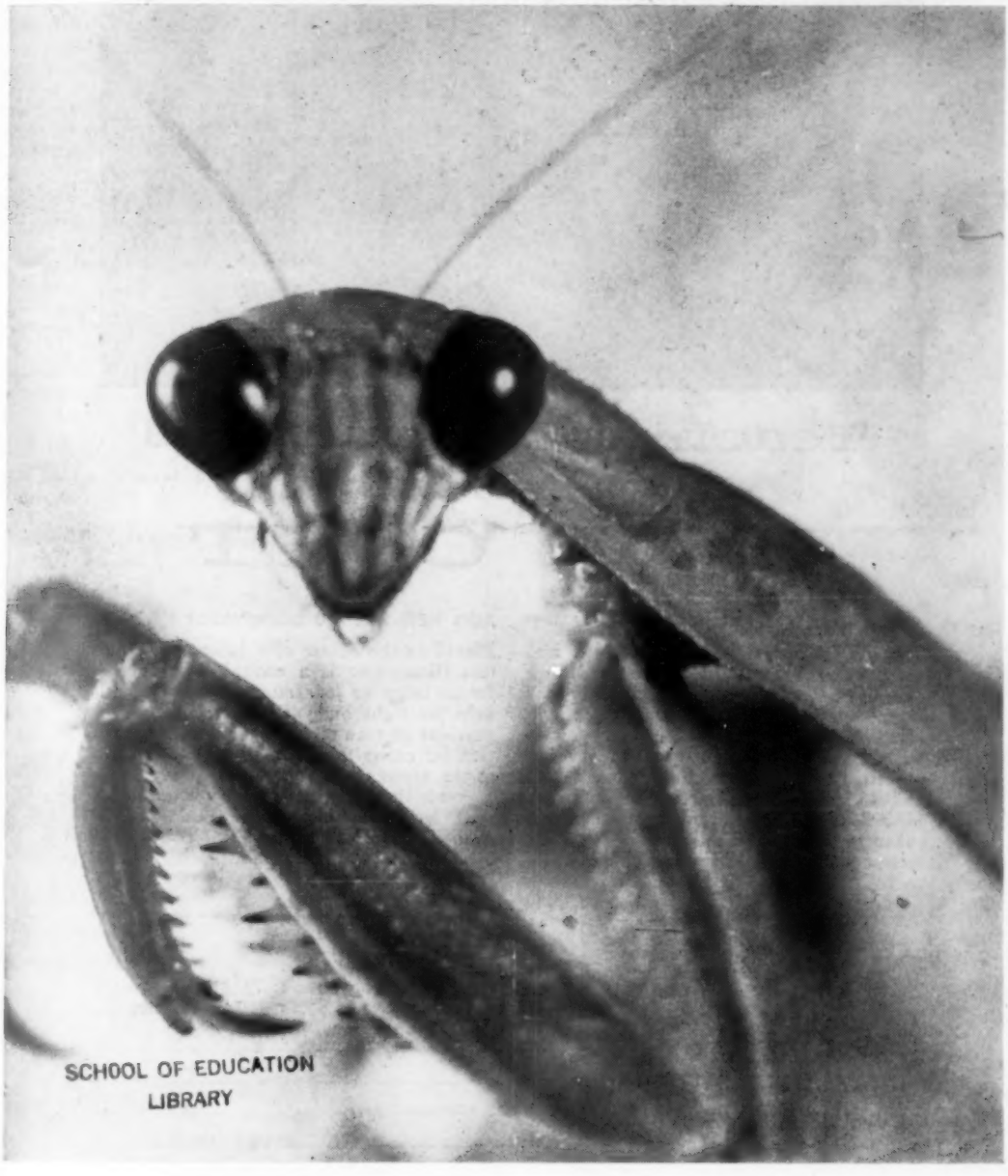

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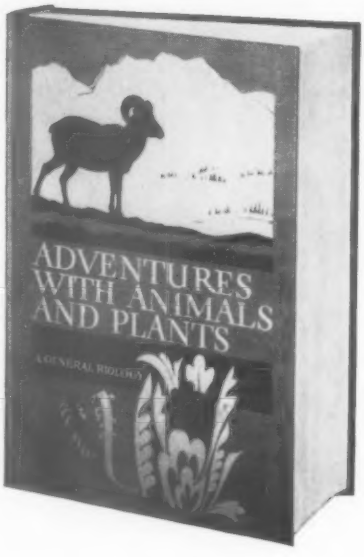

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The Bureaucracy of Education[1]

Harry J. Fuller
Department of Botany
University of Illinois

The post-war decade has brought an increase in the criticisms of contemporary public education, particularly at the high-school level, a more searching examination of the bases of current educational philosophies, an augmented interest in education on the part of parents, of university professors and administrators, and of businessmen, industrialists, government officials, and other employers of the products of our schools. Many of these criticisms and inquiries reflect honest and sincere misgivings about the practices of some of our schools, others have been promoted by jingoistic, neo-fascistic, and other crackpot groups with selfish interests to promote, or obvious axes to sharpen. That some of these criticisms and doubts have validity is supported by the increased attention being given by educators and laymen alike to the work of our public schools and by increasing complaints about the illiteracy of many public school graduates. Related to these criticisms is another serious problem, that of the educational bureaucracy which in a large measure controls our public educational system.

This bureaucracy consists in part of the faculties of our schools and colleges of education, in part of superintendents, principals, and other officials of some of our school systems, in part of powerful educational organizations of national scope and pervasive power. This bureaucracy, through the interlocking relationships of its parts, in a large measure dictates the laws which govern the certification of teachers, controls the training of large numbers of our teachers, determines educational philosophies and practices, designs curricula, and wields great influence upon the writing and selection of textbooks. Like other bureaucracies, it has its generic characteristics: it is highly sensitive to criticism and, when criticized, commonly seeks to neutralize criticisms by personal attacks upon its critics, by impugning their motives, or by attempts at suppression of their criticisms; it is self-expansive and self-reproductive in supra-Malthusian degree; it makes a fetish of methodologies; it loses the power of discrimination, so that it becomes increasingly unable to distinguish between the basic and trivial in education; and it confuses change with progress.

Evidences of the power of this bureaucracy are numerous, so numerous that I can describe only a few of them. Laws governing the certification of teachers, for example, are created ostensibly by state legislatures, but the design of these laws is in large measure of the behest of the educational bureaucracy—of the state superintendents of schools, of state boards of education, the members of which are often professors of education or persons influenced by them, and of schools of education. A study of the recent history of these certification laws indicates a common trend in many states: an increase in the number of credit hours in courses of education which must be completed by those who would gain teaching certificates. In some states, recent proposals have been made which would require as many as 40 to 50 credit hours of courses in education as a minimal prerequisite to teacher certification. Fifty credit hours of college work occupy nearly two full years of the standard undergraduate college course; a certification requirement of this magnitude would compel teacher-training students to devote most of their junior and senior years to the study of courses in education. This would mean that students preparing to become teachers of chemistry, English, commercial subjects, vocational agriculture, modern languages, bi-

[1]An article of this nature always results in a number of replies. You are invited to submit manuscripts dealing with Dr. Fuller's criticisms. The co-editors will give equal space in a future issue of *The American Biology Teacher* to the paper or papers which, in their estimation, seem to present best, the other side of the problems raised in this paper.

ology, or home economics might never complete subject matter courses in their fields of specialization beyond the freshman and sophomore levels, but would devote most of their efforts during their most important college years to courses in educational methodology, in the sociological foundations of education, in curriculum development and revision, in evaluative techniques, in the social implications of extra-curricular activities, and other such intellectual esoterica and exotica.

I do not know whether attempts to set a 50 hour education course requirement for certification have been successful in any state; that is beside the point, which is simply that regular attempts are made to increase these requirements through state laws. I do not mean to imply that all education courses are silly and useless. Certainly it is reasonable and desirable for prospective teachers to have fundamental training in child psychology, in classroom methods, and in some other fields of professional education. When courses in these fields are endlessly multiplied by a kind of academic fission, usually at the expense of training in those sound intellectual disciplines which should become a part of every teacher's equipment, then the situation becomes the counterpart of WPA leaf-raking. Parenthetically I mention that I do not consider the completion of any education course to be essential to good teaching; there are many teachers in private schools, for example, who do a superb job of teaching without having had a clutch of education courses. Further, if such courses were the *vade mecum* in the acquisition of teaching skill, then professors of education should be the very best teachers in any college or university, a condition which does not exist. If attempts are made to prevent the increase of education course certification requirements or to deflate them to reasonable proportions, the educational bureaucracy is quickly heard from—loud and threateningly. When the state of Arkansas, with the aid of the Ford Foundation, recently inaugurated a new plan of teacher training, which requires prospective teachers to complete a standard liberal arts college career, to be followed by a professional year spent in practice teaching under the tutelage of experienced and masterful teachers, professional educational organizations passed resolutions condemning the outrageous Arkansas plan.

The professional educational hierarchy has shown its bureaucratic nature in its treatment of certain of its critics. When a midwestern university press published a book by a distinguished scholar in criticism of many aspects of secondary public education, the press received letters and telegrams from school superintendents and from principals and from professors of education, protesting the publication of his book. So great were the hue and cry that the president of the university asked a staff committee to investigate the situation; after a searching inquiry, this committee issued a positive *nihil obstat* and *imprimatur*, and the book was published. When a professor at a western state university passed among his colleagues a reprint of a critical paper by the aforesaid scholar, he was fired by the president of that university, a member of the educational bureaucracy; this outrageous act was approved by an invertebrate board of trustees, who thereby aided the president in bringing disgrace to that university.

Another aspect of the operations of the educational bureaucracy is found in the pressures which it exerts upon teachers to return again and again to summer sessions, workshops, institutes, in-service courses, and round tables, usually to register for more courses in education or to hear the pronouncements of professors of education. Often teachers' promotions and salary increases are made conditional upon the frequency of their attendance at such sessions and upon the acquisition of a master's degree, which is simply a kind of union card and which is no guarantee of increased teaching effectiveness, particularly if the acquisition of that degree involves the writing of a thesis on improving the high-school annual, on the causes of academic mortality of home economics students, or upon the construction of airplane models to teach "effective living in the air age." Several of my former students have told me of the pointed suggestions made to them by their principals or superintendents that it would be well for them to work toward masters' degrees in education rather than in a biological science. Such pressures and such suggestions bespeak not only a self-serving

bureaucracy but also a circumscribed and pedestrian view of what constitutes a teacher's self-improvement. Certainly there are more imaginative and more original approaches to the betterment of teaching. It is not unreasonable to expect that the teaching of a biology teacher might be made more effective and more stimulating if that teacher were to spend a summer in a tropical rainforest or at a tropical research station in a rainforest, which is distinguished by its abundance of biology. Or that a teacher of music might profit more from a summer's work in an orchestra or from study in a voice school or from participation in a summer opera series than from courses in the social functions of music, in charm and personality development, or in the educational philosophy of music appreciation. Or that a teacher of Spanish might bring more improvement to his teaching from a summer or two in Mexico or Peru than might result from his pursuit of courses in methodologies and social implications of language teaching. Or that a teacher of history might visit and study and photograph the historical sites of our country and of Britain and France and Italy and Greece, rather than register for courses in new trends in history teaching.

I do not believe that most American teachers need to be cajoled or pressured into participation in these summer activities which might lead to their improved teaching performance. I believe that most of them have sufficient pride in their work and in their teaching ability to plan their own summer experiences with a view to the improvement of their professional ability. Certainly our public school teachers have less freedom of thought and action and thus a lower professional status than members of the other professions—law and medicine, for example—and are more directly in the hands of a bureaucracy which compels them to study the courses and work toward the degrees which the bureaucracy dictates. Further evidence of the active bureaucracy of professional education in the establishment in some normal schools of an Advanced Master's degree in Education; this degree involves one year's work (four more summer sessions) beyond the Master's degree in education and is presumably intended for those not able to achieve that steerage-class, unilingual variant of the Ph.D. degree, that of Doctor of Education.

Another feature of the bureaucracy of education is found in the emphasis placed by this bureaucracy upon methodology, often with concomitant belittling of subject matter. I remember, for example, a young lady who obtained with high honors the degree of Master of Arts in English, who, as an undergraduate had completed satisfactorily the education courses specified by the state law for teacher certification, and who sought the aid of her university's teacher placement office in obtaining a job, only to be told by a professor of education on the staff of that office, that her grades were too high, that these high grades were indicative of a scholarly nature and thus of probable failure as a teacher, and that his office would recommend her for a teaching job only if she completed another year's work for the degree of Master of Education. Then there is the case of a young lady who applied for a graduate assistantship in a university's German department; when the head of that department inquired concerning her courses in German, he was amazed to learn that she had never studied German but had studied Spanish and French, and since she was well acquainted with language teaching, was confident that she could easily pick up German language subject matter! That young lady (with a bachelor's degree in education) had certainly never read Mark Twain's essay on the German language. In 1951 a midwestern state association of school administrators listed among the characteristics of poor teachers "being in love with subject matter."

A conspicuous feature of the bureaucracy is its rapid multiplication of courses in education in many colleges and universities. The institution which is the *Urquell* of American Professional education offers about 700 courses in education. The summer school catalog of a large state university lists 81 courses in education, as contrasted with 13 courses in accountancy, 5 in agronomy, 24 in chemistry and chemical engineering, 4 in geology, 14 in history, 10 in home economics, 13 in law, 6 in physics, and 12 in psychology. At one southern state university the unlimited spawn-

ing of education courses has become so serious that the faculty council of this institution has studied these courses intensively and has made specific recommendations aimed at their reduction. The college of education of this university, for example, offers four courses in visual aids: Audio-visual Materials in Teaching, Audio-visual Methods and Materials, Organization and Co-ordination of Audio-visual Materials, and Problems in the Use of Audio-visual Materials. Among the several recommendations of the faculty council are these: that the number of courses in visual aids be reduced and that the college of education fill no faculty vacancies as these occur until that college has made serious efforts to reorganize and to reduce its courses.

It is not simple to account for the development of this self-expansive educational bureaucracy, for the factors involved in this mushroom growth are complex. We professors of the liberal arts and sciences are in part blameworthy, for we have too often ignored or looked down upon the training of teachers as one of our legitimate functions. We have too often immured ourselves in the pursuit of "scholarly" research to the detriment of our other educational duties; preoccupied with studies of the treatment of the weasel in Greek literature and its effect upon the late middle period of Johann Wolfgang von Goethe or of the Sphenopsida of the lower southwestern flank of Pike's Peak, we have by default failed to assume our rightful obligations to teacher training, and the colleges and departments of education have filled the vacuum. The educational bureaucracy may be explained in part, I believe, upon this basis: that the pursuit of graduate study and the acquisition of graduate degrees in education is a relatively easy business as compared, for example, with the successful prosecution of graduate work in chemistry, psychology, English, physics, classics, agronomy, mathematics, history, political science, and modern languages. This situation attracts to professional education large numbers of graduate students who probably lack the ability to complete satisfactorily graduate work in other fields of knowledge and these graduate students must then have jobs—hence, the mushrooming of professorships of education, of curriculum co-ordinators in our public schools, of guidance supervisors, visual aids specialists, professional testers, and others. The increase of education course requirements for teacher certification feeds this bureaucracy and thus favors its further growth. Many school principals and superintendents, beholden to some education college for their Ed. D. degrees, fertilize the growth of the educational bureaucracy through their insistence that their teachers return to summer sessions for more education courses and for advanced degrees in education.

That students registered in colleges of education frequently are intellectually less able than students in other academic fields is indicated by several studies. Tests given to large numbers of college graduates in the army in 1952 (reported in the journal *Science* of September 26, 1952) show education majors at the bottom of the heap in test scores, with students of commerce, agriculture, engineering, humanities, and the sciences outranking them. A friend of mine recently gave a test on animistic thinking to several hundred college undergraduates; results of his test again showed education students in the cellar position. It is a commonplace that students who have difficult academic sledding in liberal arts colleges frequently, upon their transfer to colleges of education, turn in satisfactory classroom performances.

I do not want to give the impression that my dorsum is entirely overgrown with Bryophyta, that I disapprove all courses in education, that I believe all school administrators to be members of what I have called the educational bureaucracy. As I have indicated, I believed that certain courses in education (albeit a small proportion of all education courses now offered) are valuable in the training of teachers; that I am not alone in this view is indicated by this quotation from a paper written by an ex-dean of one of our larger colleges of education: "Most courses and textbooks in education have little value." I know that many courageous school principals and superintendents and public school teachers are disturbed by and are unsympathetic with the educational bureaucracy in which they are enmeshed. Following publication three years ago of one of my papers

on this subject, I received letters from 793 public school teachers and administrators from many parts of our country, expressing agreement with my views. It is highly significant, I believe, and illustrative of the power of the bureaucracy that 501 of the writers of these letters included a request that I destroy their letters or that I treat their expressions of agreement as top-secret and confidential. I must add also that not all professors of education vibrate sympathetically with the bureaucracy; I know several such gentlemen who are both appalled at and worried by some of the activities of the bureaucracy. About a year ago I received a letter from an associate dean of a college of education who expressed his worry over various features of the educational bureaucracy but who added that he retired in two years and that he would simply remain quiet through the brief remaining period of his professional activity. A dean of one large midwestern school of education has stated that the granting of graduate degrees in education is an absurdity and should be halted, indicating that he is not quite in step with most professional educators.

The question now arises: what can be done to reduce the scope and power of this bureaucracy? There is no simple, ready answer to this question, for the bureaucracy is deeply entrenched, its ramifications are numerous and complex. I know of no one who has a formula which would solve this problem easily and quickly. There are, however, encouraging signs of reaction on the educational horizon, and from these we may perhaps derive hope that the bureaucracy will be trimmed to reasonable dimensions. The aroused interest of newspapers, magazines, of PTAs (some of which have begun to realize that PTAs exist to do things other than buy movie projectors and arrange fund-raising square dances and bridge tournaments), of businessmen, and of professional people in school philosophies and practices and in the educational bureaucracy is a source of encouragement. Some school boards have taken appropriate steps; in Chicago, for example, the board requires that high-school teachers must have master's degrees in the subjects which they teach, not in education; a biology teacher, for example, to qualify for employment in the Chicago high schools must hold a master's degree in one of the biological sciences. The increased realization by university administrators and facultymen that some of their colleges of education have burgeoned beyond all reason and all need and the resulting investigations of these college augur well for the future. Such investigations, carried to their logical end, might result in the shrinkage of colleges of education to departments of education within liberal arts colleges, an academic adjustment which could be highly advantageous in two ways: it would reduce the educational bureaucracy and it would bring into closer co-operation those education professors who have something important to offer students and those liberal arts professors who should play a more important role in the training of teachers.

I believe that a shrinkage of the educational bureaucracy might aid in some measure in attracting and holding superior students in the teaching profession. I believe that the current shortage of teachers is to be attributed only in part to the low salary scales of the profession; I believe that another factor is involved in the teacher shortage, namely that many young people of superior intelligence and ability become disgusted with the operations of the educational bureaucracy and, as a consequence, leave the teaching profession or fail to enter it. I know of seven very able young people who have left teaching in the last three years because they could no longer endure the bureaucracy. I quote from a letter which I received this summer from one of these teachers: "I have resigned my teaching job, for I felt that too much of my time and energy was taken up with activities and petty chores which had little to do with true education. Curricular and extra-curricular activities required about 70 hours a week of my time, although I actually taught only 25 hours a week in my classroom. The senseless paper work and chores which have little or nothing to do with true education are simply insupportable."

(Revised by the author for *The American Biology Teacher* from an article originally printed in the GAMMA ALPHA RECORD, Vol. 45, No. 2, March, 1955.)

Textbook Planarians and the Reality

LIBBIE H. HYMAN
American Museum of Natural History, New York City

The fresh-water planarians are among the most widely studied laboratory types and an account of them appears in almost every text of college biology or zoology. Examination of a number of such texts has revealed numerous mistakes and misunderstandings about planarians which the following account attempts to rectify.

In the first place the name *Planaria* is a valid generic name subject to nomenclatorial rules and regulations. As such it must not be applied to planarians in general or used as if all planarians belong to the genus *Planaria*. To the contrary, the genus *Planaria* as now defined is a small genus with only a few species. If a general name is wanted the animals should be called fresh-water planarians or fresh-water triclads.

Most textbook accounts figure only planarians with triangular heads whereas in fact the majority have truncate heads. A markedly triangular head with conspicuous auricles is characteristic of members of the genus *Dugesia* (formerly *Euplanaria*) only.

Cilia are usually limited to the ventral surface although many of the authors appear to believe that the entire surface is ciliated and that planarians move by ciliary action. In fact the characteristic gliding movement was shown by Stringer (1917) to be caused by invisible muscular waves that pass from the anterior end backwards.

A brain consisting of two rounded conjoined masses is limited to planarians with truncate heads. These texts, however, show this type of brain in types with triangular heads. Actually, the brain mass in planarians with triangular heads follows the head contour and has the general shape of an inverted V (fig. 1).

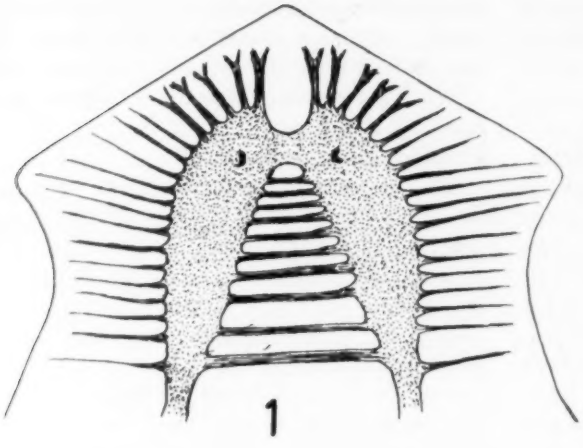
The digestive system is generally correctly understood although some figures of this system omit the pharyngeal cavity and show the pharynx lying directly in the mesenchyme, a situation in which it could not operate. The mouth is the opening in the midventral line that leads into the pharyngeal cavity (fig. 2); the orifice of the pharynx is positively not the mouth. When used the pharynx is protruded through the mouth by muscular elongation (fig. 3) and is positively not everted as stated in several of these books.

Much misunderstanding is extant concerning the food and mode of feeding of planarians. Planarians are strictly carnivorous, capturing live animals or attacking fresh corpses and positively do not eat detritus or microscopic food. As they move about, planarians leave a mucous trail in which small animals may become accidentally entangled, setting up a commotion that may attract planarians. Insects falling into water may similarly attract planarians by their struggles and constitute a chief food supply. Some planarians, notably the common white triclad of the eastern United States, *Procotyla fluviatilis* (often grossly misidentified as *Dendrocoelum lacteum*), are provided with a musculo-glandular adhesive cushion in the center of the anterior margin employed in the capture of live prey.

Planarians can ingest food only by a definite act of feeding in which they mount upon the food, grip the substrate with the body margin provided with a ring of adhesive

Legend of Plate

Fig. 1. Scheme of the brain type of a triangular-headed planarian. Fig. 2. Scheme of planarian pharynx when at rest. Fig. 3. Scheme of planarian pharynx when in use with pharynx protruded through the mouth. Fig. 4. Erroneous scheme of an excretory tubule of a flatworm, copied from Lankester's *A treatise on zoology*, volume IV. Fig. 5. Scheme of probable correct form of an excretory tubule of a fresh-water planarian. Fig. 6. Copulatory complex of *Dugesia tigrina* as viewed in vertical longitudinal section. 1, mouth; 2, pharyngeal cavity; 3, pharynx; 4, orifice of the pharynx; 5, copulatory sac (bursa copulatrix); 6, bursal canal or vagina; 7, entrance of ovovitelline ducts, after short fusion, into the bursal canal; 8, ovovitelline duct; 9, female part of antrum; 10, common antrum; 11, common gonopore; 12, male part of antrum; 13, penis papilla; 14, penis bulb; 15, spermiducal vesicles (enlarged parts of sperm ducts acting for sperm storage); 16, sperm ducts entering penis bulb.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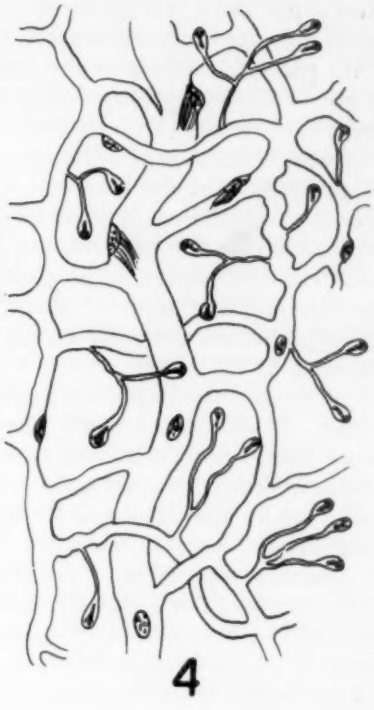
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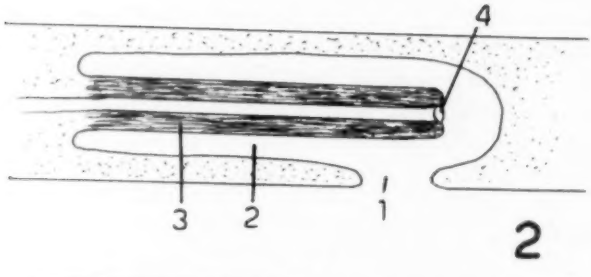
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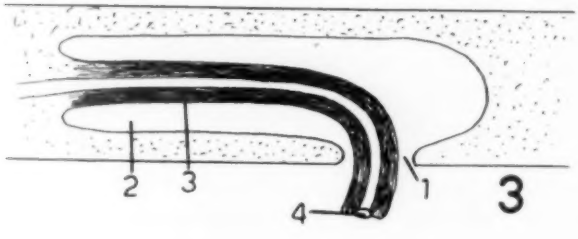
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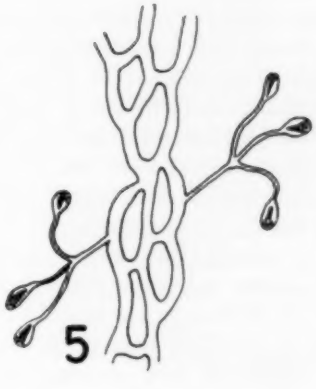
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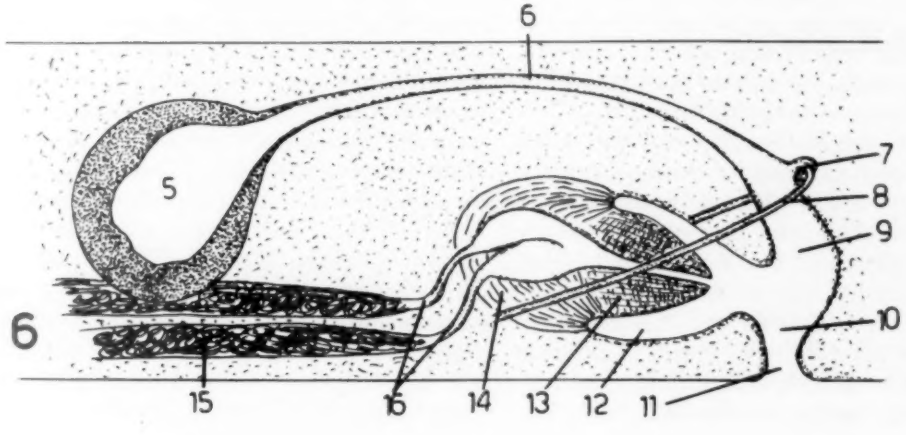
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glands, protrude the pharynx through the mouth into the food, and suck in bits of tissue by the peristaltic action of the pharynx. They do not swallow anything whole. Food is ingested only through the orifice of the pharynx, not through the mouth, which serves only for the protrusion of the pharynx. Most books indicate extracellular digestion of the food before intake into the pharynx but this has not been definitely proved although it is of course possible. The best studies indicate that digestion in planarians is wholly intracellular in the epithelial lining of the intestine that ingests bits of tissue into food vacuoles in amoeboid fashion. By feeding hungry planarians with bits of fresh insects that have been puddled in a thick paste of carmine and water, the intestine can be made to stand out with diagrammatic clarity. Several hours are required for the intestinal epithelium to phagocytize the food particles of the full intestine and about five days are required for the complete digestion of the food vacules.

Some of the worst mistakes in textbook accounts of planarians concern the excretory system. I finally traced to its source a figure of this system that has been copied with variations into a succession of texts. This figure, here reproduced as figure 4, comes from the volume on flatworms in Lankester's *A Treatise on Zoology*, where it is labelled "diagram of the platyhelminth excretory system." As a scheme for planarians this figure is bad enough but as a scheme for platyhelminths it is far worse. Almost everything about this figure is erroneous. Although it is true that in planarians in contrast to other flatworms each excretory tubule subdivides and reunites to form a net in no case is one tubule of this net larger than the others, neither do the tubules of the net loop over and under each other. There are further no bunches of cilia in the wall of the tubules and it is improbable that flame cells are attached singly directly to the main tubules, rather occurring in clusters attached to a capillary tubule. Figure 5 attempts to depict the probable form of a main excretory tubule of a planarian, but it must be realized that the excretory system is not completely known for *any* planarian and has not been described at all for *any* North American species. Because of technical difficulties the arrangement of the flame cells and their relation to the main tubules *have not been ascertained for any planarian.* Willey and Kirschner (1938) reported that the flame in the most common planarian of the United States (*Dugesia tigrina*, old name *Planaria maculata*) has the shape of a hollow cone and is not straplike as often depicted.

All the texts flounder as regards the reproductive system. This system differs in every species of planarian and hence it is not possible to construct a figure of general applicability. I will therefore confine my remarks to *Dugesia tigrina* as this is the species usually presented in college texts. In this species there is a pair of ovaries shortly behind the eyes and numerous small testes along the sides from shortly behind the ovaries to the posterior end. From each ovary but not opening into it there leads posteriorly an ovovitelline duct expanded next the ovary into a small chamber, the seminal receptacle, that contains a ball of sperm in animals that have copulated. Along their course the ovovitelline ducts receive numerous yolk glands which are clusters of large cells filled with food stores and shell-forming droplets. A delicate sperm ductule, rarely demonstrable, connects each testis with a main sperm duct of its side that proceeds posteriorly alongside the pharyngeal chamber and as it approaches the copulatory apparatus expands into a spermiducal vesicle packed with sperm during the breeding season.

The copulatory apparatus (fig. 6), located directly behind the pharynx, opens midventurally by a single gonopore by way of a chamber, the genital antrum, more or less subdivided into an anterior male antrum, posterior female antrum, and common antrum between these. The penis projects from in front into the male antrum to which its relations are identical with those of the pharynx to the pharyngeal chamber. The penis here consists of two parts, a glandulo-muscular part, the penis bulb, imbedded in the mesenchyme, and the conical projecting muscular penis papilla. The two sperm ducts approaching the copulatory apparatus from in front narrow distal to the spermiducal vesicles and pass through the penis bulb uniting into a common duct that traverses the penis papilla. From the roof of the female antrum a duct, the bursal canal, arches anteriorly above the penis and expands into a sac, the copulatory

sac, located between the pharynx and the penis bulb. The two ovovitelline ducts, also approaching from in front, ascend to either side of the penis and enter the arch of the bursal canal after a very short union.

Although the anatomy of the copulatory apparatus is such that self-fertilization is feasible, it generally does not occur and in *Dugesia tigrina* copulation is necessary to insure the laying of fertile eggs. Copulation is mutual and each worm thrusts the elongated penis through the gonopore into the bursal canal of the partner, discharging sperm into the copulatory sac. The sperm, however, do not remain in this sac, soon travelling up the ovovitelline ducts to the seminal receptacles at their heads.

Copulation is followed in a few days by the laying of an egg capsule or cocoon that contains several fertilized eggs and hundreds of yolk cells. The eggs are fertilized as soon as they leave the ovaries and in their passage along the ovovitelline ducts become accompanied by yolk cells from the yolk glands. Eggs and yolk cells accumulate in the male antrum where preformed spherules leave the yolk cells and coalesce into a capsule that hardens by a tanning process. When finished the capsule is laid through the gonopore and in the genus *Dugesia* is attached to objects by a little stalk. Under favorable weather conditions it hatches in a couple of weeks to several minute worms. Copulation and laying of capsules occur repeatedly during a breeding season that extends over a few months.

Some common mistakes may now be mentioned. The copulatory sac (erroneously considered a uterus in older accounts and often still so labelled) is usually labelled seminal receptacle; although it does in fact receive the sperm at copulation the sperm do not remain in it and the term seminal receptacle should be applied to the chambers at the head of the ovovitelline ducts. Fertilization occurs in these chambers, not as often stated or implied, in the copulatory complex. The bursal canal may be called vagina although this is not the usage among specialists on planarians. The point of entrance of the ovovitelline ducts into the copulatory complex is a common error. In *Dugesia* these ducts enter the curve of the bursal canal; in most other genera they unite to a common duct that opens into the roof of the male antrum. Many books and figures regard the expansions of the sperm ducts in the penis bulb as seminal vesicles; but these in fact never serve for sperm storage. The sperm are stored in expansions of the sperm ducts that used to be called "false seminal vesicles" until I devised the name spermiducal vesicles for them. Capsule formation takes place in the male antrum, not, as once supposed, in the copulatory sac. An old figure erroneously showing a capsule forming in the copulatory sac was repeatedly copied into textbooks but happily this has not been done in recent years.

The histology of planarians is poorly understood by the authors of college texts and poorly described and illustrated in such texts. This subject is probably too complicated for inclusion in courses in general zoology and biology. To bring out the various types of gland cells requires the use of differential stains and many of the gland cells remain quite invisible in the ordinary haematoxylin-eosin preparations. The histology of the pharynx in particular is extremely complicated and I have not seen any figure of it in undergraduate texts that was even reasonably correct. It does not appear profitable here to detail the matter of planarian histology. Those interested will find such details in my book *The Invertebrates*, volume II.

Citations

Stringer, Caroline. 1917. The means of locomation in planarians. Proc. Nation. Acad. Sciences U.S.A., vol. 3.

Willey, C. H., and P. A. Kirschner. 1938. Studies on the flame cells of Euplanaria maculata. Trans. Amer. Microsc. Soc., vol. 57.

Iowa Teachers' Conservation Camp

The Iowa Teachers' Conservation Camp will be in session again this summer at beautiful Springbrook State Park near Guthrie Center, Iowa. The Camp began operation in 1950 and has completed six successful summer seasons. This project is a cooperative endeavor of the Iowa State Teachers College, the Iowa State Conservation Commission and the Iowa State Department of Public Instruction. Five quarter hours of college credit may be gained during any 3-weeks session. The beginning

(Continued on page 129)

The Making of a Scientist

BRUCE A. SHERWOOD, Student
West Lafayette High School
Indiana

Purpose

This study of the factors which affect the development of a scientist is submitted with the hope that it will lead to a better understanding of the environment conducive to the development of the scientists so urgently needed by our country.

Pre-School Life

My father was forty-six and my mother thirty-eight when I was born; my brother was eight. I grew up in an older and possibly more mature family. I was "adopted" by my brother and his friends, so that I was exposed early to older children; for most of my childhood my friends were older than I. By the time I was six I was reading Coronet, Reader's Digest, and the Chicago Daily News. At least part of this early start is attributable to close association with older friends. Also, my mother had once taught economics and commercial arithmetic. She taught me interesting tricks one could do with numbers and stimulated my interest in arithmetic before I ever went to school.

Mother believed in giving children as much independence as possible, and she would rather say "careful" than "no." In cases in which her child wouldn't obey merely on her authority, she would, if possible, let the child find out for himself. When my brother as a baby kept trying to touch fire although repeatedly warned, she finally allowed him to burn himself slightly. Some mothers might say "How cruel!" But my brother was hurt only slightly; the pain was momentary, the lesson lasting. He had been allowed experimentation and free choice, and also shown why to respect the judgment of elders. My parents endeavored to give both of us boys a set of broad principles within which we were allowed much freedom. We were allowed to question our parents' judgment, too, and they listened reasonably to plausible complaints. So at an early age I was already asking "Why?" and receiving reasonable answers. My appetite for knowledge was whetted.

Grade School

Reading is the surest key to academic or scholastic success. Reading builds vocabulary and the larger the vocabulary the larger the number of symbols available for thinking. Because of a quantity of outside reading, school was all coasting. In fact, it would be a good idea if schools bore down on the exceptional student and made him work as hard as the normal child. A few examples of extra work are recalled: My third-grade teacher suggested that my parents get me a microscope, books, etc. In the fourth grade I was encouraged to learn the multiplication tables beyond the "required" point. But such extra projects were few and far between; I should have been forced to work harder. Schools, because of limited facilities and teacher-hours, are unable to speed up the superior student. And yet it's shameful waste to allow potential scientists to become bored or disinterested. For school was too easy. It might be expensive to give special help to special children, but it is even more expensive not to realize the full potential of the child. Our report cards had, besides the grades, a checklist: Is performing satisfactorily but is believed capable of even more; is performing satisfactorily to the best of his ability, etc. The second was always checked on my card, and yet I knew I knew even then that I wasn't accomplishing nearly as much as I could. It was too easy to loaf as long as in the eyes of the teacher I was doing superior work. *Someone should have made me work harder by giving me extra projects.*

All through grade school I was a leader in my class; Student Council, room officer, patrol-boy captain, etc. It finally went to my head, and I was more or less rejected by the class as a whole. I still had several close

friends, but only a few. This resulted in an introversion stage which lasted for several years. I read more; I thought more. I looked inside myself and analyzed my motives. I observed others and came to a much better understanding of their problems and motivations. Toynbee has noted that high culture and civilization are often the result of suppression. And so it is with the individual. Not that I was persecuted, but I didn't take a normal part in the social activities of my age group. The extra reading, projects, and introspection ultimately made me more mature when I outgrew the stage of introversion.

In eighth grade a special math class for superior students was excellent. I learned geometry, the use of the slide rule, and other advanced concepts. The general science course was so good that high school physics was just a review. An incentive in science class was the seating of "A" students in the top row and the announcement of top test scores. More of such academic competition would be a good thing.

High School

High School has been marked by academic non-competition. There isn't an area in which open scholastic competition is practiced; even an honor roll is absent. Schools which sponsor athletic competition and recognition should not be secretive about what is theoretically the more important side of school's functions. An American was astonished to see European students carrying a prize student on their shoulders and cheering him. One of the students answered the American's puzzlement, "What are your schools for?" We have not even anything like the interroom spelling bees or the incentive seating of grade school. Simultaneously it is generally agreed that competition breeds excellence. Perhaps a scientist should not need or desire popular acclaim; and yet a non-competitive system neglects a powerfully attractive goal. A few notable programs have been carried out in high school, such as a speeded-up math course for superior students, but there should be more such projects. Our school system is the finest in the world, but it could be improved by giving the outstanding pupil special attention and recognition.

Future Plans

If possible, I will major in math at DePauw University with the possibility of getting a Ph.D. at Michigan. I'd like to work in the research department of some large company such as GE or IBM.

Conclusions:

Independence coupled with intelligent guidance is very important in early family life giving the young child a good start in school. A family dinner table which is considered a panel discussion is very conducive to intelligent speech and thinking. Reading ability is an important and valuable asset, in fact the most basic academic skill. Academic incentives are good, but are not stressed enough because of limited facilities of the public school system. Outstanding children are not pushed to the limit of their abilities. Dr. Joseph Maddy, President of the National Music Camp, has said repeatedly that the American public school system does not and cannot produce young geniuses in the Mozart tradition. The public school as it is presently set up is limited by the necessity of providing "average" education for the "average" pupil. The Science Talent Search is a good example of the type of incentive goals necessary in the fields of science and technology. The young scientist needs such encouragement.

Conservation Camp

(Continued from page 127)

dates for sessions are June 3, June 24, and July 15. Much of the instruction at Camp is conducted in the field. Physical facilities at Camp are completely adequate. Each cabin accommodates eight teachers comfortably. Teachers have no part in meal preparation or in "kitchen police" duties. Food is superb.

The Camp experience provides an excellent opportunity for teachers to gain background knowledge concerning resources and resource management. In addition, teachers have an opportunity to learn from first-hand experience in the field under the capable leadership of visiting resource persons. For further information concerning the Camp and its program, write Dr. H. Seymour Fowler, Director, Science Department, Iowa State Teachers College, Cedar Falls, Iowa.

Summer Institutes

PAUL KLINGE
Howe High School, Indianapolis, Indiana

Institutes for this summer to improve high school and college biology teaching are appearing with more frequency. This certainly underscores the appreciation for the need of better biology teaching on all levels in the American educational system. In the two following announcements the National Science Foundation is the fund granting agency.

The only program exclusively for high school biology teachers is the one announced for Indiana University from June 25 to August 3, 1956. The Summer Institute for Teachers of High School Biology will be sponsored by Indiana University and NABT. Thirty-five participants will be chosen from nominations to be received by Mr. Paul Klinge, Howe High School, Indianapolis 7, Indiana, who will act as Assistant Director of the Institute. Professor Shelby Gerking, Professor of Zoology at Indiana, will be the Institute Director. Room, board, tuition, travel expenses, and dependent's stipends will be completely assumed by the Institute. Credit arrangements can be made with the University. The purpose of the curriculum will be to present modern concepts in certain biological fields, interdependence of the sciences, demonstrations of useful teaching tools and devices, and discussions of curriculum and teaching problems. The new air-conditioned life sciences building at Indiana University will be the site of the Institute, and its facilities will be open for the use of the participants. The visiting staff will be made up of prominent scientists; there will be a great deal of freedom permitted in the use of the laboratories, and the student will be encouraged to assume initiative in his laboratory and field work. Although Indiana residents will be given preference in participant selection, nominations will be accepted from teachers living in surrounding states. This is another method by which NABT is cooperating with local agencies in helping to improve biology teaching. NABT members, especially, should apply to Mr. Klinge by April 15. A complete program for the Institute will follow in later issues.

The University of Utah will conduct an Institute for College and High School Teachers of Biology this summer. It will be open to 25 college and 25 high school teachers. Dr. Loren C. Petry, University of Missouri, will act as director, and NABT member Dr. Stanley Mulaik, University of Utah, will be Associate Director. Stipends will average $250.00 per participant and preference will be given to teachers in smaller colleges and high schools.

A Letter from the President

JOHN P. HARROLD

Dear NABT Members:

In accepting the gavel of office from Brother Charles at the inauguration ceremony held at Atlanta, Georgia, I realize the responsibility that goes with it. I am happy, as well as humble, to be honored with the opportunity to serve as President of the National Association of Biology Teachers. It is my hope that I can carry on with the help of you, the members, the fine work that has been done by Brother Charles and other past presidents. Only with the cooperation of the members, can your officers do their best in promoting the interests of our association which are directed toward better science teaching in the field of biology at all levels.

To me, one thing seems to be demonstrated by this Atomic Age, and that is, scientists more than ever before have found they need each other. It will take the combined efforts of the mathematician, physicist, chemist, and biologist working hand in hand to make the most of what lies ahead in science.

It was nice meeting many of you in Atlanta. It is my sincere hope that because of your experiences at our meetings you have returned to your classrooms with new ideas and renewed enthusiasm, courage and determination to do all in your power to improve your teaching of biology. And to those of you who were unable to attend, may I say that I cannot describe the lift and enthusiasm that can be reborn by attending a national meeting.

Begin now making your plans to attend our next meeting in New York City. No matter how long you have been teaching, to realize *you can* improve yourself professionally by attending our annual meetings, is one of the surest signs that progress is being made.

The Biology Teachers Work Center at Purdue University

RICHARD R. ARMACOST
Associate Professor of Biological Education

A view of the Biology Teachers Work Center.

The Department of Biological Sciences and the Department of Education at Purdue University cooperatively maintain a materials work center primarily for teachers of biology, elementary school science, and general science. The center is located in Stanley Coulter Hall in the Department of Biological Sciences.

This Work Center houses science and science education periodicals; texts for high school biology, general science, and elementary school science; a variety of reference books for students of various grade levels and their teachers; laboratory manuals and workbooks; pamphlets; courses of study; units developed by teachers and prospective teachers; charts; aids for student projects; laboratory equipment; tapes of "Ask the Biologist," a radio program for high school students and their teachers; and many other materials particularly useful to teachers of the biological sciences.

"Ask the Biologist," referred to above, is a weekly radio program sponsored by the Department of Biological Sciences. It represents a means of taking many members of the biology staff, via radio, into the high schools of Indiana. Each week about 10,000 students and their teachers listen to question-answer broadcasts or interviews centered around biology topics of interest to high school students and their teachers. Outstanding Purdue University biologists, high school teachers and administrators, and high school students with special science aptitudes appear on the va-

rious programs. A sincere effort is made to present the material in such a way that it is understandable, educational and enjoyable. Tapes are available of all broadcasts. These are used in the Center or sent on request to high schools in the State. Some schools have the programs dubbed off onto their own tapes and build up a tape library for use in their biology courses.

Teachers, administrators, prospective teachers, and other students are welcome to use the Center at all times except for the three hours each week when classes for prospective biology teachers are being held. Often arrangements are made for evening use of the Center. Practically all materials can be borrowed for periods of time ranging from a few days to a month, depending upon how many people need a certain item at a given time. The author's office is adjacent to the Work Center which gives him the opportunity to meet with those who come for materials and information. This is helpful to those who visit the Center and enables him to become better acquainted with his students and others who visit the Center.

The Biology Teachers Work Center is used in a number of ways. The methods course in the teaching of the biological sciences meets in this room. This permits the instructor to demonstrate, display and call attention to various materials of interest to prospective high school biology teachers. Informal work sessions can be held so that the methods course ideas can be developed and demonstrated with the materials at hand. This helps eliminate the "talk, talk, talk" aspect present in too many methods courses. The Center is also used by the high school biology practice teachers in the development of their teaching plans.

Biology teachers inservice often use the Center. It affords a fine opportunity for them to see and evaluate books, charts, laboratory equipment and other materials which they may wish to purchase for their own schools. They can discuss the appropriateness of these materials for their specific school situations, with the Biological Education Professor in charge of the Center. Whenever teachers bring students to the campus for such programs as the Sci-Math Assembly, the Regional Science Fair, the City and County Teachers Conferences, or come to the University for

A prospective high school biology teacher discusses her teaching plans with her advisor.

Workshops and other summer programs, the Work Center is a major interest.

A final use of the Biology Teachers Work Center was not anticipated when it was being developed. Many undergraduate as well as graduate college students and professors drop in to read the numerous periodicals and brouse through the variety of interesting books. These people are, for the most part, only casually interested in teacher education.

The members of the Department of Biological Sciences and the Department of Education at Purdue University are proud of the Biological Teachers Work Center. They realize its usefulness to teachers inservice, prospective teachers and in course work. They are pleased too, that many persons who are not intimately concerned with science teacher education gain an interest in the Work Center and enjoy dropping in during their leisure moments.

WORLD OUTSIDE MY DOOR. Olive Bown Goin, housewife, biologist and nature writer. 184 pp. $3.50. The Macmillan Co., New York 11, New York. 1954.

In this book, a housewife-naturalist explores the living wilderness in her own backyard (Gainesville, Florida). The daily and seasonal life of the animals around her—frogs, lizards, turtles, songbirds and the like come vividly to life. The book is illustrated with line drawings, and should interest both the zoologist and the general reader.

The Guidance of Young Women for Careers in Natural Sciences

DOROTHY ALFKE
Penn State College

As in most of our guidance work with young people, the guidance of young women for careers in natural sciences presents some special challenges. We must be able to inform interested girls of the many different opportunities and help them learn enough about these fields to make a wise choice. We must help them to realize that in some fields the opportunities are limited either because the total number of positions is small or because the nature of the work is such that men are often given preference. We can also help these young girls increase their chances of success by suggesting ways to acquire the training and experiences which will best qualify them for the kind of work they wish to do.

To help meet the first challenge of providing information on the variety of positions, two sources of written material are suggested. The Women's Bureau of the United States Department of Labor recently published a series of pamphlets on opportunities for women in the various sciences. These deal, primarily, with laboratory research and other technical positions. Recent articles in the *American Biology Teacher* have discussed educational work and other lesser known opportunities related to natural sciences. References such as these can help a young girl expand her outlook when considering a career. Also important are visits to various agencies such as research laboratories, museums, botanical and zoological gardens, hospitals and government agencies. By talking with the personnel in these places, a girl can better see herself in relation to the kind of work involved. In some cases, volunteer or part time work experiences might be arranged. A teacher or guidance counsellor can do much to initiate and implement these experiences which are so valuable to a young girl trying to discover the kind of work for which she is suited. These methods of exploring the various fields can also yield information on relative numbers of opportunities for employment. With respect to certain types of work some generalizations can be made. There is a real need for adequately prepared personnel for the different kinds of educational work related to natural sciences. For these positions, women candidates are usually given equal consideration with men and sometimes they are given preference. In laboratory research, women seem to have little difficulty in obtaining beginning positions but several women report that their chances for advancement do not seem equal with those of men in similar positions. The opportunities for women in positions involving field research are extremely limited. Only those young women who are singular in their interest and qualifications for such work should be encouraged to prepare for field research. Some types of work such as illustration, writing, photography, radio and television, and museum preparation are in themselves so limited that it is probably unwise for any person to prepare exclusively for a career in any one of these. It would be better for a girl interested in a limited field to develop fully her aptitude along these lines as part of a training program for educational work or some other broad area.

Whatever the vocational goal may be, the chances of success can be greatly increased by a carefully planned program of preparation. This is especially true for the types of work for which no college curriculum patterns exist. By way of illustration we might consider a young girl interested in doing some kind of nature education work, either at a museum, school camp or government conservation agency. Since certification for teaching is required for some of these positions and desirable for the rest, her undergraduate training probably can best be obtained at a teacher training institution which offers some good elective work in the natural sciences. If this

college program includes little or no field work she might attend Audubon Nature Camps or other field study programs for one or more summers. She should also spend some summers as a camp nature counsellor or as a staff member in a nature museum. Extra curricular activities during the school year might include some of the following: assisting with Girl Scout work, participating in a photography club, working on a school publication, assisting in a biology laboratory and membership in a folk dancing group or outing club. Graduate work for additional training in the natural sciences will probably be necessary.

As another example, we might consider a girl interested in laboratory research in some biological field. Her college program should include basic course work in physics, chemistry, botany, zoology and bacteriology. These will help her decide where her interests in the biological sciences lie. Even after her decision is made, her preparation should be kept as broad as possible to qualify her for several beginning positions in her field. Because of the variety of laboratory research positions, guidance in choice of subject matter course work should be obtained from college faculty members or persons employed in the field of interest. In addition to subject matter preparation some basic work in statistics may be advisable. Since graduate work is practically essential for a career in laboratory research, a reading knowledge of at least one foreign language is needed. Through volunteer work, part-time employment or summer jobs, some of the following experiences can be of value: work in a science laboratory such as preparing culture media, stockroom work, washing glassware or assisting in a research project.

Similar consideration of other types of work would further point up the importance of making good use of summer vacations and extracurricular activities. No one training plan can be prescribed for any type of work but careful planning is important and should take into consideration the extent to which the vocational goal has been determined, the abilities and past experiences of the individual, the financial resources and the available opportunities for training and experience.

Valuable help in planning, as well as other advantages can be obtained by seeking the advice of successful workers in the field. These people can help one to gain a more realistic picture of the jobs in their field and can make suggestions as to skills and special training which might increase the chances of success. They can often recommend schools where the best training is available for work in their field. If they feel a young girl is suited to the work, they might offer the use of their names as reference or help her obtain a summer position to gain experience.

In addition to these general principals which can be applied to almost any career in natural science, some suggestions may be made for special fields.

Museum administrators seem to prefer museum people when positions are to be filled. Therefore, the girl who desires work in this field should recognize the importance of any work experience, volunteer or paid, in museums as well as any contact with the personnel of these institutions.

State and federal conservation agencies tend to adhere to a promotion from within policy. Also some administrators in these organizations are reluctant to employ a woman for a professional position unless they have some reassurance as to her sincerity of purpose, soundness of subject matter preparation and ability to work well with other staff members. This suggests that a girl interested in employment with government agencies might well include in her preparation some training to qualify for an entry position such as secretary, statistical clerk, laboratory technician, or editorial assistant. The record of some successful women shows that this has been an effective approach to professional level positions.

Individuals interested in work with agencies whose programs are concerned with forestry, agriculture, fish and game conservation or nature education should seek opportunities for practical experiences with the related natural resources. These might include farm work; hobbies of fishing, hunting and camping; attendance at conservation camps or workshops; and visits to resource industries.

A young girl interested in laboratory research should choose a college at which she

(Continued on page 137)

Pictorial Report of the Atlanta Meetings

John Harrold accepts gavel.

Paul Webster looks at student exhibit.

J. W. Kercheval speaks.

Robert Platt speaks.

Edward M. Ray speaks.

Robert C. McCafferty speaks.

Pictorial Report (continued)

The panel reports action resulting from the Southeastern Conference on Biology Teaching.

Ned Bingham speaks.

Victor Greulach speaks.

Emery L. Will speaks.

E. K. Weaver speaks.

Guidance — Women . . .

(Continued from page 134)

will be working under recognized leaders in the field of interest. Successful study under such persons is often, in itself, a strong recommendation. The value of secretarial skills, experience in report writing, and mastery of laboratory skills and technique was stressed by many women engaged in laboratory research. One highly successful woman recommended that a young girl develop a specialty such as a knowledge of one taxonomic group, the pathology of a disease, or a special laboratory technique. This often makes it possible to establish a reputation through publication or consultant work.

It is significant that women have achieved success, in terms of both salary and recognition, in all types of work related to natural science. Better guidance and training will produce better qualified women candidates. This will be a contribution toward an improvement of the work done by the employing agency and in an improvement of opportunities for women in the natural sciences.

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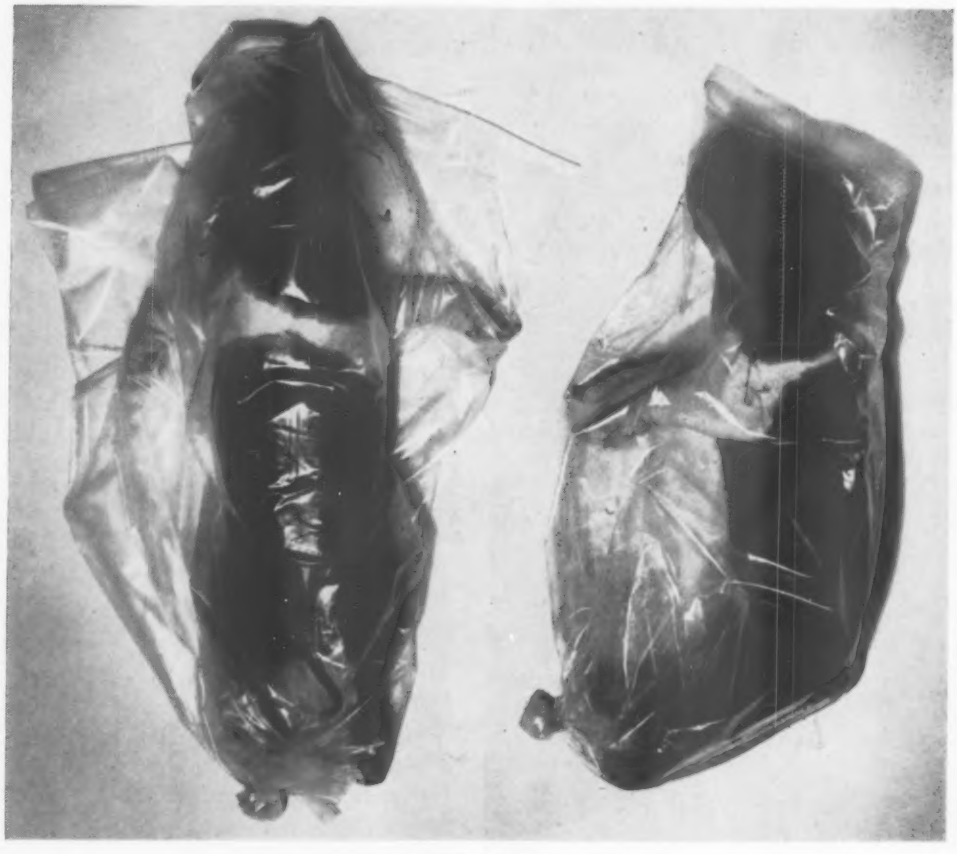

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